EXPLORING THE NATURE OF WEAK CHANDRA SOURCES NEAR THE GALACTIC CENTRE

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RESUMEN

El resumen será traducido al español por los editores. We present early results from the first IR imaging of the weak X-ray sources discovered in a recent *Chandra* survey towards the Galactic Centre. From our VLT observations we will identify likely counterparts to a sample of the hardest sources in order to place constraints on the nature of this previously unknown population.

ABSTRACT

We present early results from the first IR imaging of the weak X-ray sources discovered in a recent *Chandra* survey towards the Galactic Centre. From our VLT observations we will identify likely counterparts to a sample of the hardest sources in order to place constraints on the nature of this previously unknown population.

Key Words: **STARS: BINARIES — STARS: INFRARED — STARS: MASS LOSS — STARS: X-RAYS**

1. *CHANDRA* GALACTIC CENTRE SURVEY

An imaging survey with *Chandra*/ACIS-I of the central 0.8×2° of the Galactic Centre (GC) revealed ∼800 previously undiscovered discrete sources with X-ray luminosities of 10^{32}−10^{35} ergs s^{-1} (Wang et al. 2002). Our calculations suggest that the extragalactic contribution to the hard point source population over the entire survey is ≤10%. The harder (≥3 keV) X-ray sources (for which the softer X-rays have been absorbed by the ISM) are likely to be at the distance of the GC, while the softer sources are likely to be foreground X-ray active stars or cataclysmic variables (CVs) within a few kpc of the Sun. These hard, weak X-ray sources in the GC are therefore most likely a population of X-ray binaries (XRBs); candidate classes include quiescent black hole (BH) or neutron star low-mass XRBs, CVs, and high-mass wind-accreting neutron star binaries (WNSs).

2. WHAT ARE THESE POINT SOURCES?

Pfahl et al. (2002) have considered the likely nature of these sources and concluded on the basis of binary population synthesis models that many of these systems are WNSs. Depending on the mass of the companions, the WNSs may belong to the "missing" population of wind-accreting Be/X-ray transients in quiescence or the progenitors of intermediate-mass XRBs (IMXBs; donor mass 3-7$M_\odot$). This *Chandra* survey may contain as many as 10% of the entire Galactic population of WNSs. In addition to the WNSs, Pfahl et al. estimate that a small fraction of these sources could be CVs or transient BH binaries.

3. OUR VLT IMAGING PROGRAM

To identify counterparts to a statistically significant number of the X-ray sources, using ISAAC on the VLT we obtained high-resolution *JHK* images of 26 fields within the *Chandra* survey region, containing a total of 70 X-ray sources. For the early-type donors of the WNSs, we expect intrinsic magnitudes of K=11-16; these are therefore readily distinguishable from the majority of late-type donors expected for BH X-ray transients which have K ≥16 in quiescence. The average extinction towards the GC is K ∼3; therefore by imaging to a limit of K=20 we should detect most of the WNSs.

The successful achievement of our goals requires astrometric accuracy and high angular resolution to overcome the confusion limit of the crowded GC. There is no archival systematic IR imaging survey which we could use for this project. The 2MASS survey has a limiting magnitude of K=14.3, and although the astrometric positions are accurate to 0.2", the survey has a spatial resolution of ≥2". As such, the 2MASS data are severely confusion limited in the GC and moreover are of insufficient depth to detect the majority of the expected counterparts. Our VLT images are not confusion limited (Figure 1) and are complete to K ∼20. For 90% of the X-ray sources in our VLT fields, there are one or more resolved IR sources within each *Chandra* error circle.

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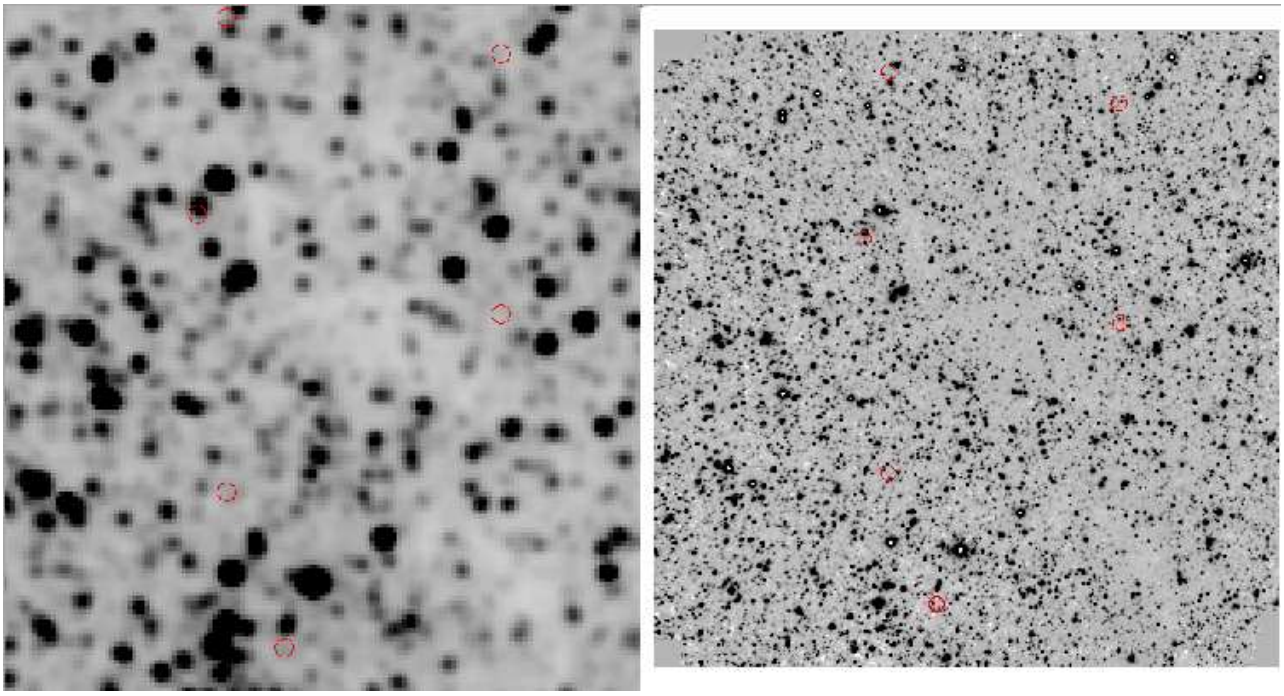

Fig. 1. 2MASS (left) and VLT (right) K-band images of one of our GC fields. The circles (*Chandra* error circles with 2" radius) indicate the positions of X-ray sources. The brightest stars are clearly visible in both the 2MASS and VLT images; however, the VLT image is considerably superior in depth and resolution.

The distribution of X-ray colours suggests that only a small fraction of the *Chandra* sources are foreground objects. The next steps in the analysis of these datasets are (1) to derive accurate astrometric solutions for both the IR and X-ray images; (2) to determine IR colours for the potential counterparts within the X-ray error circles; and ultimately (3) to identify candidates for IR spectroscopic follow-up observations in order to establish accurate spectral types for this population.

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